

SOIL SURVEY OF THE JANESVILLE AREA, WISCONSIN.

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LOCATION AND BOUNDARIES OF THE AREA.

The area described in the present report is covered by two topographical sheets of the Geological Survey, known as the Janesville

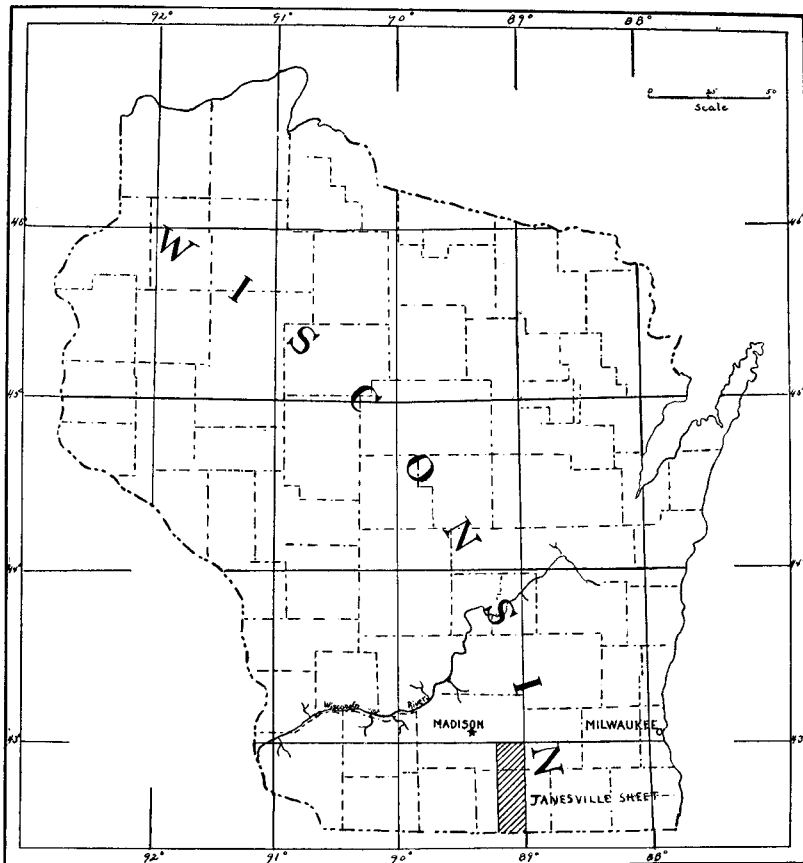


FIG. 14.—Sketch map showing area surveyed in Wisconsin.

and Stoughton sheets. Each of them includes an area 30' long by 15' broad. The area extends from the Wisconsin-Illinois State line, $42^{\circ} 30'$ north latitude, to 43° north latitude. It slightly exceeds 450 square miles in extent. It comprises all of the townships of Beloit, Newark, Rock, Plymouth, Janesville, Center, Fulton, and Porter, in

Rock County, and all of Dunkirk and Albion, with the greater part of Christiana and Pleasant Springs townships, in Dane County. The eastern and western borders of the area overlap the limits of the above-mentioned townships by about a half mile. The important manufacturing cities of Janesville, Beloit, Edgerton, and Stoughton lie within the area. It is crossed by both the Chicago and North-western and the Chicago, Milwaukee and St. Paul railroads. Rock River and Yahara River flow across the area, furnishing water power at many points. Lakes Kegonsa and Koshkonong border on the area. (See fig. 14.)

HISTORY OF SETTLEMENT AND AGRICULTURAL DEVELOPMENT.

The country of which the Janesville area forms a part was first discovered and explored by French fur traders and Catholic missionaries. It lay on the border of the territory occupied by the Illinois Indians until their final disappearance before Iroquois war parties. The earliest Indian occupants found by the white men consisted of bands of Winnebago and Potawatomi. Villages of the Winnebago were located at Beloit, near Janesville, at the mouth of the Yahara River, and on the banks of Lake Koshkonong. Besides hunting and fishing these tribes raised small amounts of maize.

Until 1832 only a few scattered trappers and hunters of the white race had ever visited the Rock River country. In that year the army of General Atkinson, sent to defeat and punish Black Hawk, chief of the Sacs and Foxes, marched through this region, encamping at various points in the present area. After the successful termination of this campaign many of the soldiers engaged in it, returning home, told of the fertile prairies and "oak openings," of the abundant water supply, and the beautiful lakes they had seen. This carried the first definite knowledge of the country to the outskirts of civilization, and the pioneers, easily persuaded of a better land just beyond, started forward to the new region. In 1835 John Inman, of Pennsylvania, and William Holmes, of Ohio, made an exploring trip to the junction of the Rock and Yahara rivers. They returned there in the fall of the same year, accompanied by Thomas and Joshua Holmes, Milo Jones, and George Follmer. Samuel St. John and his wife, the first white woman to reach the area, came the same year, and were followed in 1836 by Dr. James Heath and wife. Their settlement was made on Rock prairie, south of the present town of Janesville. This same year, 1835, a Government land office was opened at Green Bay and the first sale was made of land west of Rock River. In 1839 a land office was established at Milwaukee and the land east of Rock River was sold.

In the early days of settlement grain constituted the largest part of the farm produce. Wheat, corn, barley, oats, and rye were raised. Produce was marketed at Chicago or at some one of the Illinois towns.

shipping grain down the Mississippi River. Manufactured articles were brought in by way of the Great Lakes. In 1845 the publication of the first newspaper was begun, and in 1850 the first railroad reached the area. Since these events flourishing cities have grown up, ample facilities for transportation have opened broad markets, and the population of the area, both urban and rural, has greatly increased. The production of wheat has steadily decreased, while that of oats and corn has as steadily increased. The old dependence upon grain as an export crop has passed away. The grains now produced are chiefly fed to live stock, while tobacco forms the most important money crop. Probably there are as many farmers buying grain for feeding as there are selling grain for export. The result is easily seen in the productive fields and well-kept farms.

CLIMATE.

The following table gives the normal monthly and annual temperature and precipitation as compiled from records of the Weather Bureau station at Beloit:

Normal monthly and annual temperature and precipitation.

Month.	Temperature.	Precipitation.	Month.	Temperature.	Precipitation.
	° F.	Inches.		° F.	Inches.
January	18.4	1.90	August	70.6	2.86
February	20.8	1.30	September	62.4	3.60
March	31.8	2.16	October	50.4	2.40
April	48.0	3.30	November	35.1	2.00
May	57.8	3.88	December	25.0	1.93
June	69.0	3.80	Year	46.9	32.68
July	73.3	3.55			

The average date of last killing frost in spring at Beloit is May 6, and of the first in fall is October 3. This gives an average growing season for tender vegetation of one hundred and fifty days. The latest killing frost of spring to occur since 1853 came May 20, 1895, and the earliest in fall September 20, 1896, and on the same date in 1897.

PHYSIOGRAPHY AND GEOLOGY.

The topography of the Janesville area is that of a typical glaciated area where neither glacial erosion nor glacial deposition has completely obliterated preglacial erosion features. It is a region of low, rounded hills and ridges interspersed with broad, flat valleys and stretches of level prairie bordering the major streams in poorly defined terraces. The altitude of the area above sea level ranges from about 740 feet near Beloit to a maximum of over 1,100 feet upon the highest hills in

the Dane County portion of the area. There is no constant relationship between the topography and the distribution of the soil types, nor is there any definite arrangement of the soil types according to geological derivation. The general trend of the hill masses corresponds to old subaerial erosion forms fixed by preglacial erosion.

Rock River is the principal stream draining the area. Its chief tributaries are the Turtle River, the Yahara River, Marsh Creek, and Bass Creek. Koshkonong Creek flows into Lake Koshkonong. Rock River flows in a deep-cut channel between hills and past bordering terraces of open prairie. Its banks are formed in part by cliffs of sandstone and limestone, in part by gentler slopes of glacial till, and in part by narrow, low-lying strips of meadow land formed largely by wash from higher levels. This stream carries a considerable volume of water, which is utilized at many places for milling purposes. The Turtle and Yahara rivers, though of much smaller volume, are very similar. They are both utilized for water power. The remaining streams of the area are insignificant in size and flow through large tracts of meadow and marsh land. Throughout the area there are many small lakes and ponds, and portions of Lake Koshkonong and Lake Kegonsa are included in the map. Many gravel knolls and ridges, distributed seemingly at random throughout the area, indicate former locations of subglacial drainage which, roofed and walled by the ice sheet then existing, forced their content of water, sand, and gravel across the country with little regard for topography, like huge natural flumes or pipe lines. When the ice disappeared from the surface of the country the traces of these old channels were left in their gravel deposits, called "eskers" by the glacial geologists. Similarly the ice left behind it as it melted the finely ground detritus, derived partly from areas farther to the north and partly from local underlying rock, in the form of a continuous sheet known as the till. In the long years which have succeeded the withdrawal of the ice this till has been prepared by the frost, the rain, and the encroachment of vegetation; that is, through the natural processes of weathering, for the purposes of agriculture. This till thus constitutes the material from which the majority of the soil types of the area have been derived. One other form of glacial deposit is well represented in the area. During the withdrawal of the glacial ice there were numerous halts, when the glacier front stood for some time nearly in one position. At such times an excess of *débris* accumulated along the frontal margin in the form of moraines. Such a deposit occupies the extreme northern portions of Janesville and Center townships and the southwestern corner of Porter township. This belt consists of hummocky knolls of sand and gravel covered with large-sized boulders of granite, diabase, quartz-porphyry, diorite, and mica and hornblende schists, all derived

from an area of crystalline rocks in the Lake Superior district. Boulders of similar character occur less numerous throughout the entire area.

In the extreme northern portion of the area are found a large number of lenticular hills arranged with their longer axes nearly parallel and having a northeasterly and southwesterly trend. The material composing the central core of each of these hills consists of a gravelly gray or drab till which in each case rests upon a floor of limestone or sandstone rock. The central core usually has a veneering of loam, in some cases forming the Janesville silt loam and in others the Edgerton silt loam types, as is also the case with the other till deposits of the region. This gravelly till is found at few other places in the area. It differs markedly from the materials giving rise to the soil types, and seems to indicate beyond question an earlier glaciation correlative with the Illinoian glaciation farther south, while the greater part of the glacial material comprising the surface of the area belongs to the more recent Wisconsin till sheet. These lenticular hills, called "drumlins," are remnants of the old glaciation carved into their present shape, given their uniform parallel trend, and veneered over by a distinct deposit, through the operation of the ice at a later period.

The consolidated rocks underlying the glacial deposits exert little influence on the surface soils. These rocks consist of thin-bedded, somewhat shaly limestones and of coarse-grained saccharoidal St. Peter's sandstone of Silurian age. The limestones frequently contribute narrow bands of stony soil where the Janesville silt loam has been worn thin through long-continued erosion. The St. Peter's sandstone has contributed largely, both during the period of glaciation and since, to the sand content of some of the types, for instance, the Miami loam. The coarse, rounded quartz grains found in that type are very similar to the round grains of the St. Peter's sandstone. The limestone of this region furnishes some fair quarry stone and has been utilized for burning into quicklime. If properly crushed it might serve as a better material for the surfacing of highways than any other material found in the region. It is abundant and cheap, easily crushed, packs and cements well, and will outwear the gravel used so largely in the roads of the area.

A large part of the silty clay subsoils of several of the types could be used as needed for the manufacture of brick, tile drain, and other terra-cotta articles. This area is well located for manufacture, being about midway between the coal deposits of Illinois and the iron and copper deposits of the Superior region.

SOILS.

Ten soil types are found in the Janesville area. Their location and boundaries are shown on the map, and their chief peculiarities are

described in the report. The extent of each is shown in the following table:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Janesville silt loam.....	81,344	28.2	Muck.....	10,368	3.6
Edgerton silt loam.....	81,216	28.2	Mackinaw gravel.....	9,024	3.1
Miami loam.....	51,968	18.0	Janesville loam.....	6,656	2.3
Meadow.....	18,112	6.3	Miami black clay loam.....	1,856	0.7
Afton fine sandy loam.....	16,256	5.6	Total.....	288,448	.....
Hanover sand.....	11,648	4.0			

JANESVILLE LOAM.

The Janesville loam consists of a surface soil of fine brown loam from 12 to 14 inches in depth. It is underlain to a depth of several feet by a fine, massive, yellow loam of very uniform texture. It is neither markedly clayey nor sandy. The Janesville loam constitutes the principal type found on the Rock Prairie. It occupies both sides of the river near Janesville and attains its greatest development beyond the eastern border of the map. The surface is almost uniformly level, being interrupted only by shallow stream channels of little length or breadth. This type normally grades off along its margins into the Miami loam. Between the two types no sharp boundary exists.

The complete underdrainage of this soil type is insured by the presence beneath its subsoil of thick layers of gravel and sand. No underdrainage has been attempted on the Janesville loam, nor does it seem necessary.

This type has long been valued for its grain-producing capabilities. Under average seasonal conditions the yield of corn is about 60 bushels per acre, that of oats from 45 to 50 bushels, of barley about 40 bushels, and of hay 2 tons to the acre. The average tobacco yield of the Janesville loam is about 1,400 pounds per acre. (See Pl. XXXI.) A first-class quality of binder leaf is secured. With proper fertilization tobacco may be raised several years in succession on the same field. The Janesville loam constituting the open prairie and bordering upon Rock River was one of the first soils selected for settlement by the early pioneers. It has maintained a high degree of fertility from 1835 to the present time.

The following table gives the mechanical analyses of this type:

Mechanical analyses of Janesville loam.

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
7088	3¼ miles N. of Janesville.	Brown loam, 0 to 12 inches.	P. ct. 5.78	P. ct. 0.10	P. ct. 0.48	P. ct. 0.40	P. ct. 0.90	P. ct. 6.10	P. ct. 72.86	P. ct. 18.38
7092	Janesville	Brown loam, 0 to 10 inches.	3.97	.20	1.58	2.08	2.04	5.28	68.14	20.32
7090	.....do	Brown loam, 0 to 18 inches.	2.77	.10	.74	.74	1.12	4.60	70.88	20.88
7093	Subsoil of 7092	Yellow silty loam, 10 to 36 inches.	.94	.04	1.58	3.46	3.00	6.30	69.82	15.50
7089	Subsoil of 7088	Yellow silty loam, 12 to 38 inches.	1.49	Tr.	.30	.30	.94	6.84	75.60	15.92
7091	Subsoil of 7090	Mottled silty clay, 18 to 36 inches.	1.28	.10	.74	.86	1.32	4.96	75.54	16.02

JANESVILLE SILT LOAM.

The Janesville silt loam consists of about 10 inches of mealy chocolate-colored loam that has a deep reddish-brown color when wet. This is underlain by a sticky, reddish-yellow silty clay, with a depth of 30 inches or more. The subsoil normally rests upon gravel or upon the prevalent limestone rock of the region. In Plymouth and Newark townships, of Rock County, small areas of Janesville silt loam differ from the general type in possessing a thickness of only 12 or 14 inches. In these areas there are many small patches where the surface is strewn with broken fragments of shaly limestone. These patches usually lie on the steeper hill slopes and owe their origin to the removal, through erosion, of the greater part of the overlying soil. Throughout the entire area of the Janesville silt loam there are found small hills and hummocks of rounded gravel and of sand, while the steeper slopes are commonly more sandy than the average of the type.

The Janesville silt loam finds its most extensive development in Janesville, Center, Porter, Dunkirk, Pleasant Springs, and Christiana townships. (See Pl. XXX.) It is uniformly rolling or hilly and is thoroughly well drained by many small streams. The Janesville silt loam owes its origin to deposition of glacial material. It rests either upon the consolidated rock or upon glacial gravel, and many erratic boulders from the Lake Superior region are found over its entire extent.

It is one of the strongest and most fertile soil types of the region, forming the larger portion of the original rolling prairie of southern Wisconsin. It produces, under average seasonal conditions, from 50

to 60 bushels of corn per acre, from 40 to 50 bushels of oats, about 1½ tons of hay, and 1,200 pounds of tobacco. It is only less desirable than the Janesville loam of the Rock Prairie and constitutes one of the finest soils of the region for general farming. It is too heavy a type for the production of wrapper tobacco, though producing a good quality and large quantity of the binder leaf.

The following mechanical analyses show the texture of this soil:

Mechanical analyses of Janesville silt loam.

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.
7074	1½ miles NW. of Stoughton.	Brown silty loam, 0 to 8 inches.	4.87	0.12	0.56	0.56	1.44	6.20	76.98	12.44
7084	5 miles W. of Edgerton.	Brown silty loam, 0 to 6 inches.	3.01	.20	2.44	3.62	7.06	7.26	64.24	14.66
7072	3 miles NE. of Hanover.	Reddish-brown loam, 0 to 12 inches.	4.14	.38	3.70	5.42	7.32	6.66	60.24	16.24
7078	2 miles SW. of Fulton.	Brown loam, 0 to 12 inches.	6.20	.10	.58	.52	1.88	4.16	69.02	23.50
7075	Subsoil of 7074.....	Reddish-yellow silty clay, 8 to 36 inches.	1.14	.04	.58	.54	1.60	6.98	79.48	9.94
7079	Subsoil of 7078.....	Reddish-yellow silty clay, 12 to 36 inches.	1.38	.42	.88	.68	2.00	6.58	74.16	15.14
7073	Subsoil of 7072.....	Loam, 12 to 36 inches.	1.35	.04	1.26	2.58	3.54	8.34	68.22	15.84
7085	Subsoil of 7084.....	Silty clay, 6 to 36 inches.	.86	.08	1.66	2.40	2.74	6.10	70.18	16.08

EDGERTON SILT LOAM.

The surface soil of the Edgerton silt loam is composed of about 8 inches of very fine sandy to silty loam. When dry it is ash colored to light gray, and when moist light brown in color. It is underlain to a depth of several feet by a stiff, silty yellow clay subsoil that is uniformly mottled with gray markings. Both soil and subsoil are lighter colored than the Janesville silt loam.

This soil type occupies the hill country in southern Rock and Plymouth townships and throughout Fulton, Albion, Dunkirk, Christiana, and Pleasant Springs townships. It alternates with the Janesville silt loam, forming broad bands across the area.

The Edgerton silt loam is fairly well drained, but requires tile under-drainage for the purpose of furnishing a thorough air circulation to the subsoil as well as to remove excess of rain water. This soil type is also one of the products of the former glaciation of Wisconsin. It

more nearly approaches typical glacial till than any other soil in the area. It is frequently interrupted by long, narrow ridges and oval, conical hills of gravel and boulders. Many granite, diabase, and schist erratics are scattered over the surface of this type. Throughout its area are also found large numbers of conical or irregular depressions without outlets, known as kettle holes. These frequently contain water during a part or all of the year.

The Edgerton silt loam, though originally in part forming open prairie, consisted chiefly of oak openings. Even at the present time the greater proportion of the oak timber in the area is found on this soil type. The crop yields on the Edgerton silt loam average from 45 to 50 bushels of corn per acre, about 40 bushels of oats, from 1 to 1½ tons of hay, and from 1,100 to 1,200 pounds of tobacco.

The following mechanical analyses give the texture of the Edgerton silt loam:

Mechanical analyses of Edgerton silt loam.

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>
7064	4 miles SW. of Fulton.	Fine gray loam, 0 to 12 inches.	3.10	0.10	1.06	1.08	2.86	8.20	72.80	12.98
7066	3 miles NE. of Stoughton.	Fine loam, 0 to 6 inches.	2.17	.06	.72	.80	2.40	7.84	74.44	13.72
7062	8 miles N. of Janesville.	Fine brown loam, 0 to 6 inches.	2.53	.34	2.12	1.30	2.58	9.72	69.20	14.52
7060	4½ miles SE. of Hanover.	Fine loam, 0 to 12 inches.	3.95	.02	.20	.48	1.20	3.86	79.34	14.62
7067	Subsoil of 7066.....	Mottled silty clay, 6 to 36 inches.	.61	.00	.46	.66	1.56	7.22	72.46	16.74
7065	Subsoil of 7064.....	Mottled silty clay, 12 to 36 inches.	.64	.00	.58	.40	1.10	5.88	71.44	19.82
7061	Subsoil of 7060.....	Yellow clay, 12 to 36 inches.	1.02	.01	.08	.22	.74	3.98	74.86	20.00
7063	Subsoil of 7062.....	Yellow clay, 6 to 36 inches.	.61	.20	1.90	1.60	2.46	7.18	59.34	27.20

MIAMI LOAM.

The surface 8 inches of the Miami loam consists of a compact brown loam containing from 15 to 30 per cent of coarse, rounded quartz sand. This sand content varies through moderate limits over single fields. From 8 inches to an average depth of about 18 inches the subsoil consists of a sticky, reddish sandy loam, frequently spoken of locally as "sandy clay." This is uniformly underlain by a deeper subsoil of fine to medium gravel imbedded in a sticky matrix of sand and clay. This soil type is found on the level prairie bordering both

sides of Rock River, along the Bass Creek Valley from the Rock River past Leyden toward Evansville, over the hills near Center, and similarly upon the hills in the northern part of Beloit Township. Small areas are also found near Orfordville and in the extreme northern portion of Pleasant Springs Township, Dane County.

The surface of the Miami loam is about evenly divided between level prairie land and rolling hill country. In both cases it is well drained. There is not a sufficient amount of clay in the subsoil nor a sufficient depth to the subsoil in the Miami loam to produce large yields in a dry season. It furnishes a warm seed bed and gives early germination for all crops. The average yield of corn on this type is about 40 bushels per acre, that of oats about the same, while hay produces from 1 to 1½ tons. The yield of tobacco is about 1,100 to 1,200 pounds to the acre, and, during the season of 1902 at least, the texture of the leaf raised on this type approaches more nearly to the wrapper grade than any other produced in the region. The ordinary crops suitable for canning purposes may be raised to advantage on the Miami loam.

The following mechanical analyses show the texture of this soil:

Mechanical analyses of Miami loam.

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>
7096	5½ miles NW. of Beloit.	Brown sandy loam, 0 to 9 inches.	2.80	0.34	7.90	20.78	27.64	6.50	24.02	12.46
7098	5½ miles NW. of Janesville.	Brown sandy loam, 0 to 6 inches.	3.34	1.94	15.54	14.40	13.00	4.16	34.30	16.52
7094	3 miles S. of Janesville.	Brown sandy loam, 0 to 10 inches.	3.12	1.54	12.48	15.70	10.58	3.88	38.34	17.10
7095	Subsoil of 7094....	Sandy loam, 10 to 40 inches.	.89	4.50	22.76	24.20	13.80	2.60	20.20	11.52
7097	Subsoil of 7096....	Coarse sandy loam, 9 to 24 inches.	1.51	.40	8.72	19.14	27.04	5.90	24.36	14.34
7099	Subsoil of 7098....	Sticky sandy loam, 6 to 18 inches.	2.08	1.62	15.80	15.74	13.06	2.16	32.28	19.26

AFTON FINE SANDY LOAM.

The surface soil of the Afton fine sandy loam consists of 18 inches of brown loamy sand from medium to fine in texture. It is underlain by a medium to fine yellow sand from 2 to 5 feet in thickness. Locally a small amount of fine gravel is scattered through both soil and subsoil.

Small areas of this type are found near the water level along Rock River and its principal tributaries, but the largest areas of Afton fine

sandy loam are found between Rock River and Sugar River along the State line. The greater part of this soil type consists of gently sloping or nearly level fields, usually well drained and easy to cultivate.

This soil is probably almost entirely derived from deposits of fine sand laid down by streams issuing from the glacier front during the final retreat of the glacial ice, though some of the smaller areas, especially along Rock River, have been formed from accumulations of sand carried down by rain wash from the Miami loam.

This soil forms the nearest approach of any in the region to the sandy truck soils of the Eastern and Central States. It is more loamy and not so coarse in texture as the typical truck soils. The Afton fine sandy loam produces medium crop yields. Corn yields from 35 to 40 bushels per acre, oats about 35 bushels, hay about 1 ton, and tobacco about 1,100 pounds of good leaf. The weight per acre of tobacco is not as great as upon those soils containing more clay, but the leaf is somewhat thinner and of better texture. This soil is adapted to the production of sugar corn, green peas, tomatoes, and other crops which mature early. It seems the nearest approach to a soil adapted to the production of wrapper tobacco of any type found in the area.

The following mechanical analyses show the texture of this soil type:

Mechanical analyses of Afton fine sandy loam.

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>
7056	1 mile S. of Afton..	Brown sand, 0 to 12 inches.	1.47	0.20	4.84	28.54	47.40	4.04	8.56	5.74
7054	1½ miles SW. of Dunkirk.	Fine brown sand, 0 to 9 inches.	2.27	.46	7.70	17.44	24.44	4.52	35.76	9.88
7058	4½ miles NW. of Beloit.	Brown loamysand, 0 to 18 inches.	2.25	.34	5.90	20.34	44.54	5.50	11.84	10.58
7057	Subsoil of 7056.....	Red sand, 12 to 36 inches.	.79	.20	4.48	29.10	48.84	3.74	6.58	6.16
7059	Subsoil of 7058.....	Brownish-red sand, 18 to 38 inches.	.97	.40	5.80	22.08	51.54	4.66	8.38	6.78
7055	Subsoil of 7054.....	Red loamy sand, 9 to 38 inches.	.45	.20	5.38	17.70	33.56	5.56	23.86	13.06

HANOVER SAND.

The Hanover sand consists of a surface 10 inches of grayish-brown sand and fine gravel. This surface soil usually rests upon a subsoil of sticky yellow sand or upon sand and gravel. In some instances it is underlain by sandstone or limestone rock. The surface soil is a medium to fine-grained sand, which is sharp and angular and packs to

a firm, compact surface. Usually only 10 or 15 per cent of fine gravel is present in the surface soil. The main areas of this soil type are found in Plymouth and Newark townships. Only small areas are found elsewhere. The surface is usually rolling or sloping and the type is well drained throughout the area.

The Hanover sand is largely an accumulation from the wash of the Afton fine sandy loam or the Miami loam. In other cases it has been formed by the complete or partial erosion of the Miami loam, only the subsoil portions of that type remaining.

The crop production of the Hanover sand is below the average of the region. It is too sandy a type to produce large yields except in an extremely wet season. The average yield of corn upon this soil is about 35 bushels per acre, that of oats about 30 bushels, of hay about 1 ton, and of tobacco about 1,000 pounds, except upon newly cleared land, where the yield is greater. The texture of the tobacco raised on this type is good.

This soil type is greatly in need of the addition of more organic matter. For this purpose crops of cowpeas and of clover should be plowed under and the use of stable manure should be increased.

The following mechanical analyses give the texture of the Hanover sand:

Mechanical analyses of Hanover sand.

[Fine earth.]

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>
7069	11 miles NW. of Beloit.	Gray sand, 0 to 16 inches.	1.07	1.52	14.08	26.16	30.12	6.58	14.58	5.38
7068	Hanover	Medium gray sand, 0 to 16 inches.	.87	1.04	12.54	19.54	30.08	6.60	21.54	8.38
7070	1½ miles S. of Rio.	Brown sand, 0 to 6 inches.	2.06	.34	4.54	10.70	36.40	18.30	20.90	9.58
7071	Subsoil of 7070....	Red loamy sand, 6 to 20 inches.	.70	.90	4.24	10.14	34.90	19.00	18.78	11.80

MACKINAW GRAVEL.

The Mackinaw gravel consists of a coarse gravelly soil and subsoil mingled with sandy loam. It is formed by the outcrop of thick gravel bands along the stream courses and by the exposure of gravel knolls and ridges left by the glacial ice over the hills and uplands of the area. Several stony areas and a few rock outcrops have been included in

this type in the mapping. Many small areas of a few acres in extent have been omitted on the map. They are all easy of detection, forming a conspicuous feature of the landscape. They are usually too small to be represented without exaggeration on a map of the present scale. This soil contains from 35 to 50 per cent of rounded or sub-angular gravel. The majority of the pebbles are from 1 inch to 3 or 4 inches in diameter, though boulders of much larger size are of not infrequent occurrence. The fine earth associated with the gravel is usually quite sandy.

The difficulty of cultivating these gravelly and stony areas, both on account of their texture and of the steep slopes usually occupied, has led to the extensive use of the Mackinaw gravel as pasture land. In many instances small groves and clumps of trees have been left standing. This type possesses no especial agricultural value, though grapes do well upon such a soil.

No mechanical analysis has been made of this soil type.

MIAMI BLACK CLAY LOAM.

The surface soil of the Miami black clay loam consists of a sticky black clay loam about 10 inches in depth, locally containing some very fine sand. The surface, when dry, cracks and crumbles into a granular mass of clayey fragments closely resembling the "buckshot" soils of the Mississippi Valley. It is then easily cultivated and possesses all the peculiarities of a friable loam. When thoroughly wet the surface soil packs to a plastic clayey mass. From a depth of 10 to 40 inches the subsoil consists of a sticky yellow or blue clay, somewhat mottled through the presence of hydrated salts of iron.

All of the Miami black clay loam areas are found associated with the Meadow and Muck of the region. Both of these other types, if properly drained, would add extensively to the area of Miami black clay loam. The Miami black clay loam has been formed by the same processes as the Meadow and the Muck, differing from the latter by a much larger proportion of mineral matter to organic matter, and from them both by a somewhat better natural drainage.

The Miami black clay loam is extensively developed throughout the prairie States. Over its entire extent it is preeminently a corn soil, producing from 60 to 90 bushels per acre. In each case when first farmed it was in a thoroughly water-soaked and swampy condition, and was only brought to its present high state of fertility by tile drainage. Extensive areas in Ohio, Indiana, Illinois, and Iowa have been so drained and have amply proved the desirability and profitableness of such reclamation. Hundreds of acres in Wisconsin are awaiting this treatment.

The following mechanical analyses give the texture of the Miami black clay loam. Comparison should be made with analyses of the same type from Illinois and Ohio.

Mechanical analyses of Miami black clay loam.

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
7102	3 miles SW. of Hanover.	Brown loam, 0 to 7 inches.	P. ct. 9.92	P. ct. 1.64	P. ct. 8.50	P. ct. 7.08	P. ct. 13.42	P. ct. 7.88	P. ct. 55.38	P. ct. 6.12
7100	3½ miles NW. of Albion.	Brown sandy loam, 0 to 10 inches.	4.21	.50	1.68	3.58	14.40	5.54	64.98	8.44
7101	Subsoil of 7100.....	Dark clay loam, 10 to 38 inches.	.58	.22	.96	.84	2.56	3.40	76.10	15.88
7103	Subsoil of 7102.....	Black clay, 7 to 36 inches.	4.28	.04	.34	.96	2.60	5.06	73.24	17.66

MUCK.

The surface soil of the Muck consists of about 12 inches of organic matter mixed with sand and clay. It is usually underlain by 3 or 4 feet of mottled yellow or blue clay. In other cases the surface soil rests upon a coarse gray quicksand. Nearly all of the Muck areas lie along stream courses, and in many cases are surrounded by meadows. The Muck areas are uniformly flat and are usually covered by bunches of coarse grass or reeds; scattered clumps of willows also occur. The existence of these Muck areas is due entirely to lack of natural drainage. Originally existing as small lakes or ponds, rain wash from the hills has partly filled them up, and water-loving vegetation has encroached around the margins. This mingling of organic and mineral matter has produced a sticky black soil, usually saturated with water.

These areas are best adapted to the production of onions, celery, cabbages, and cucumbers. In many instances further artificial drainage is necessary before any cultivated crop can be raised. For this purpose a broad, open ditch should be excavated by a dredging scow. Laterals should then be laid with tile drains, and the reclaimed land used at first for the production of grass and corn. These crops should be followed by celery, cabbages, and cucumbers. In some instances the quicksand underlying the Muck would have to be avoided in the construction of the main drainage ditch. Its position could be easily determined through the use of an inch and a half soil auger or a long

iron rod. In other localities lands of similar character, reclaimed at an expense of less than \$20 an acre, are now valued at from \$100 to \$200 an acre. It is to the interest, not only of the owners of these lands, but also of the general community, to have them drained, since the presence of this saturated mass of soil exerts a harmful influence on surrounding cultivated fields. The taxable basis of the county would also be increased.

MEADOW.

The Meadow lands in the Janesville area consist of low, flat, poorly drained areas lying along stream courses, near the margins of lakes, or, in some cases, in extensive hollows which once formed lakes, but which have since been naturally drained and filled. The texture of the soils found in these localities varies considerably. It usually consists of wash from higher-lying lands, mingled with considerable organic matter. A lack of adequate natural drainage is a common characteristic of all the meadows.

At the present time they are furnishing large quantities of rather coarse marsh hay, and after the cutting of the hay crop are used for pasturing stock. They are particularly valuable for this purpose, since the excess of moisture which prevents cultivation maintains a luxuriant growth of grass at a time when the upland pastures begin to fail.

In many cases the areas mapped as Meadow could be reclaimed through the use of tile drain, and would form excellent corn ground. A very moderate slope will give sufficient fall, and the total expense for the drainage should not exceed \$12 or \$15 an acre. In case of the larger Meadow areas a single large open ditch with tiled laterals would form the best drainage system. In most instances a small amount of drainage would throw these Meadow areas into the same condition as adjoining soil types. For this reason some of the narrower strips and small isolated patches have been omitted from the map.

TOBACCO.

The cultivation of tobacco in the Wisconsin area was begun in 1858 by growers who introduced the crop from the East. The Connecticut type was first raised, but it has been superseded by the Spanish binder tobacco derived from West Indian seed. The crop was first raised in small garden plots and fields. It has since increased in importance until, in 1899, 33,830 acres of tobacco were raised in the State. The area of production has spread from a few farms in Rock and Dane counties until it comprises about all of the south central portion of the State. In 1899 over 45,500,000 pounds were produced.

The Wisconsin tobacco is chiefly of the binder type, about 80 per cent of the crop belonging to this class. About 5 per cent is of

proper texture for wrappers, while the remaining 15 per cent, consisting chiefly of ground leaves, broken stock, and fleshy upper leaves, constitutes filler. The characteristics of the Wisconsin binder leaf are as follows: It must be of a good burning quality with a white ash; it must be tough and elastic, with medium sized veins; the lighter colors are preferable, but this is not so important as is the case with the wrapper leaf; a clear, glossy face is desirable but not essential. It has been noticed with the Wisconsin leaf that it loses its gloss to a certain extent after being wrapped on the cigar. The average size of the Wisconsin leaf is from 18 to 20 inches in length and from 10 to 14 inches in breadth. The color is a medium shade of cinnamon brown. The Wisconsin leaf averages a yield of about 1,300 pounds per acre for the area. This yield is frequently exceeded. The average price to the farmer is about 6 or 7 cents a pound. The crop is usually sold from the barn and is quoted for binder and filler grades; for instance, a crop may be sold at 8 and 2 cents a pound, the prices being quoted for the two grades. The average cost of production is said to be 3 to 3½ cents per pound. Much of the Wisconsin tobacco is handled very roughly during harvesting and curing, and some improvement might be made in this respect, although the low price per pound would not justify any great refinement in method. (See Pl. XXXII.)

The method of cultivation and handling of the Wisconsin crop is not sufficiently different from that of other tobacco districts to require a special description. The curing in this climate takes from six weeks to four or five months. The latter time is required when the crop is frozen before being completely cured in the fall. After curing the tobacco is sorted at the shed into binder and filler grades. The buyer usually views the crop in the sheds and buys according to his estimates. Recently competition among buyers has led to some selling from field estimates. The tobacco, after being removed to the warehouses, is sized to 1½-inch limits in length of leaf. It is then packed in large bulks containing about 5,000 pounds, where it is allowed to remain for about fifteen days. During this time fermentation is begun and the tobacco goes beyond the danger of black rot. It is then packed in cases of about 350 pounds weight and the fermentation completed.

The tobacco fields of Wisconsin are fertilized chiefly with barnyard manure, and nearly every tobacco farm is also a stock or dairy farm. In spite of the liberal use of this fertilizer it is noticed that the fields located on the newer lands produce a larger quantity and better quality of tobacco than those of the older fields which have been liberally fertilized with stable manure. The use of special commercial fertilizers is scarcely known in the area, only \$6,000 worth of this class being used on the 4,000 farms of Rock County in 1899. In order to restore the older tobacco lands to some measure of their former productivity it will be necessary to employ nitrogen and potash fertilizers.

Of these cotton-seed meal has been most successfully used in other areas as a source of nitrogen and some form of potash as a source of that element. The introduction of the sugar-beet industry into the area, foreshadowed by initial experimental crops, would be of service to the tobacco growers, since the cheapest vegetable potash supply is derived from the burned refuse of the sugar-beet factories. The amount of cotton-seed meal necessary to produce the best results makes it a very expensive fertilizer. Some growers use as much as 1 ton per acre, costing them \$30 to \$35 for this single item. This expenditure would probably not be justified with the binder type of leaf, but carefully conducted experiments should soon develop the best practice regarding this and other special fertilizers.

For several years the most progressive tobacco merchants in Wisconsin have felt that the necessities of a balanced tobacco trade required the production of some form of wrapper tobacco within the limits of the State. With the initiation of the shade-grown Sumatra leaf in the Connecticut Valley some of them became more than ever desirous of introducing this particular class of tobacco into the Wisconsin area. In the season of 1902 Messrs. S. B. Heddles and F. S. Baines, at their own expense, built shade areas, the former inclosing about 2 acres and the latter nearly 1 acre under canvas. The framework of both tents was better constructed than the average of the Connecticut tents, and both gentlemen report the cost of their equipment as considerably higher than that prevailing in New England. Both experiments were undertaken on the Janesville loam, Mr. Heddles's tent being located near its margin and Mr. Baines's upon Mr. Snell's farm, well within the limits of the type. This soil is considerably more clayey than any upon which Sumatra tobacco has been grown successfully in New England. In addition, the season of 1902 was unfavorable to such an experiment, being marked by excessive rainfall during the growing season and by an average temperature considerably below the normal. In spite of these unfavorable conditions both crops appeared well at the time of harvesting, showing a luxuriant growth reaching nearly or quite to the tops of the tents and yielding a large amount of tobacco to the acre. As neither crop has been cured as yet it is impossible to state that the experiments have met with complete success. Certainly much has already been learned and thus far the experiment may be called successful. Further trials will be made by the gentlemen interested.

In selecting new areas for experiments in the production of wrapper tobacco the experience of other areas would indicate that the most sandy types found in the Janesville area are more liable to bring success than the heavier soils at present preferred for the binder tobacco. Thus no competition occurs between the two grades, either in production or consumption, and each serves to supplement the other in the American tobacco trade.

AGRICULTURAL CONDITIONS.

The general appearance of the Janesville area is that of a well-conducted, successful agricultural community in which the agriculture is closely linked and prospers with the flourishing manufacturing industries of the cities of the region. Beloit and Janesville, cities of more than 10,000 population, are each the seat of considerable manufacturing. In both the production of agricultural implements holds a prominent place. Edgerton and Stoughton likewise are considerable manufacturing towns. Janesville, Edgerton, and Stoughton are prominent centers of the Wisconsin binder-leaf tobacco trade. The many warehouses in each of the cities employ a large number of hands in the sorting, grading, and packing of the crop. Tobacco from outlying districts is brought to these centers for warehouse handling. In addition to the above interests these towns manufacture furniture, cloth, clothing, and various other articles of commerce. Large quantities of tobacco are also manufactured into cigars within the district.

The agricultural lands of Wisconsin are all laid out according to the section and township surveys of the United States General Land Office. The land was originally occupied by the earliest pioneers through a system of squatter rights generally accepted by the pioneers themselves. After the completion of the original Government survey the pioneer occupants secured good Government titles through purchase from the Land Office. The first claims have long since been divided and subdivided until at the present time Rock County, with a total area of 720 square miles, comprises 3,829 farms, of which 3,762 are improved with buildings. The total value of farms for the county amounts to over \$20,000,000. The additional value of the farm buildings amounts to over \$5,800,000. Throughout the county the average size of the farm is 112 acres, slightly less than the average for the State. The average value of the farms is about \$5,250 each, with improvements other than buildings, while the average value of the buildings on farms thus improved is \$1,550. The average value of farm products not fed to cattle amounts to \$1,137 per farm annually. This represents a gross income of 17 per cent on the investment, without counting the value of live stock maintained on the farm. In Dane County the average size of the farms is 115 acres and the other averages range only slightly less than in Rock County. The portions of these two counties included in the present area are very fairly represented by statistics of the counties as a whole.

The greater proportion of the farms in the area are operated directly by their owners or through managers who are paid a fixed salary. Over 80 per cent of the farms are thus operated. The remaining farms are operated in about equal numbers by money tenants and share tenants. The farms are maintained in much better condition than in regions where share farming is more prevalent.

The buildings are substantial, neat, and well painted. The fences, chiefly of wire, are carefully maintained. Nearly every farm is provided with windmill and tanks, supplying water for both household and farm use. The greater number of the farms in the region, in addition to a comfortable dwelling house of wood, brick, or stone, are provided with a small stock barn with hayloft, with cornercribs and outbuildings for minor stock, and with one or more large tobacco sheds. When not in use for hanging tobacco, other farm products and the farm machinery are stored in the tobacco sheds. The ruinous practice of leaving farm machinery exposed to the weather is noticeably absent in this area.

The majority of the farms in the Janesville area are devoted to general agriculture as distinguished from specialized branches, such as trucking and market gardening. The greater number maintain small herds of dairy cows and some beef stock. A few hogs and various kinds of poultry are usually kept, chiefly for the needs of the farm. Many flocks of sheep are also found in the area. The principal crops raised are field corn, sugar corn, oats, rye, barley, sorghum—usually in small patches—potatoes, and tobacco. Beets and turnips are raised to a limited extent, while the production of cabbages and cucumbers, which with the sugar corn are sold to the canning factories, is steadily increasing. Hay is one of the chief crops, while a considerable area is devoted to pasturage. In addition to the tame grass of the upland fields, considerable marsh grass is cut from the lowland swamps and meadows. Two crops of hay are frequently cut in a year and considerable amounts of timothy and clover seed are thrashed annually. The dairying industry is constantly increasing in importance throughout the region. Formerly the butter was manufactured as a farm dairy product. While this practice still continues upon many farms, the greater part of the milk is sent to creameries, many of which are located in the area. Very little cheese is manufactured. A large proportion of the butter finds a ready local market. The special industry of tobacco raising is described in a separate chapter.

On account of the small average size of the farms, and particularly because they are chiefly operated by their owners, the labor of field operations is principally performed by the farmer or by members of his family. The average expenditure for farm labor in Rock County amounts to only \$110 per year for each farm. A considerable proportion of this is paid out during the harvesting of hay, grain, and especially the tobacco crop. During the balance of the year very few extra hands are hired. In the production of the tobacco crop a somewhat novel variation on the share system has been originated. The land owner or the renter possessing the stock, land, implements, and building for handling a crop of tobacco plants as much as he himself can handle without hiring additional labor. He then prepares ground for an additional tobacco area which is handled both during

the growing season, during harvesting, and curing by "sharemen," who give him one-third or one-half of the crop for the use of the land and the labor involved in its preparation.

All of the soil types found within this area are used for general farming purposes, and any recognition of the special adaptability of any one soil type to a particular crop is limited to a more or less defined conception of the amount of the crop which can be raised upon different farms. For instance, it is recognized that the Janesville loam of the Rock Prairie, the Janesville silt loam of the upland prairie, and the Edgerton silt loam of the "oak openings" will produce larger crops of hay, grain, and tobacco than the more sandy soils such as the Miami loam, the Afton fine sandy loam, and the Hanover sand. It is also recognized that the tobacco leaf raised on the sandier soils is frequently thinner and of finer texture than that raised on the more clayey soils, but since the yield per acre is considerably greater on the heavier they are considered the best tobacco soils of the area. This is due to the fact that only one variety of tobacco, the binder leaf, is advantageously grown in Wisconsin. Consequently the chief aim is to secure the largest leaf and the greatest possible weight per acre.

Of the ten soil types found in the Janesville area the Janesville loam will produce the largest yields of hay, grain, and binder tobacco. It compares favorably with the typical corn soils of the prairie States, approaching most nearly the Delavan silt loam of Tazewell County, Ill. The Janesville loam is the most desirable general farming soil of the area, not only on account of its superior fertility and admirable physical texture, but also on account of its position near the largest cities, its excellent natural underdrainage, and its nearly level surface configuration.

The Janesville silt loam is second only to the Janesville loam as a general farming type. In fertility and physical texture they are very nearly equal, though the Janesville silt loam does not possess as great a depth either of surface soil or of subsoil as the Janesville loam. Its surface is also much more rolling and therefore subject to greater wash from heavy rains. Its yields of hay, grain, and tobacco are proportionately slightly smaller than those of the Janesville loam, and a greater proportion of the former than the latter type is devoted to pasture land. It thus becomes one of the chief stock and dairy types of the area. It is usually well handled, productive, and above the average value of farm lands.

The Edgerton silt loam is not naturally as fertile nor of as good physical texture as either of the preceding types. In addition its surface is more rolling, more subject to wash, and more frequently interrupted by small patches of bowlders or gravel. It is thus more difficult to till and harder to retain in its best state of cultivation. It furnishes the greater proportion of the pasture and grass lands of the

area. Allowing for variations in the ability of the producers, the weight of tobacco per acre is less and the size of leaf smaller as raised on the Edgerton silt loam than on either of the preceding types. The productive ability of this type of soil, the certainty of producing a crop, and the ease of tillage could all be materially increased by the expenditure of about \$10 per acre on tile drainage, not to reduce the water supply in the subsoil but to institute a more thorough circulation of the soil solutions and the soil atmosphere. In addition to this a suitable crop rotation should be worked out through experiments by the farmers themselves or under the direction of their State agricultural experiment station. To summarize: The chief need of this type is a better circulation in the subsoil and more organic matter in the surface soil.

The above types constitute a group of general farming soils, reasonably distinct from the other soils of the region.

The Miami loam, while of medium value for general farming, is rather light and possesses too shallow a subsoil to compare favorably with the three types already described. It possesses a greater value than any of them for certain special crops used in the canning industry. For the production of sugar corn, of green peas, of tomatoes, etc., it is as well fitted as any soil in the region. Cantaloupes, watermelons, strawberries, and other small fruits could be raised to advantage. Thus the Miami loam occupies an intermediate position between the general farming soils and the truck soils, and is best described as a market-garden soil. The steady growth in population of the manufacturing cities of this region will increase the requirements for market-garden crops, to the advantage of this type of soil.

The Afton fine sandy loam, though not as coarse in texture as the typical truck soils of the Eastern and Southeastern States, approaches more nearly to them than any other type found in the area. It is capable of bringing truck crops to rather early maturity and should supplement the Miami loam, crops on which would mature still later. It likewise approaches the nearest to a type suited for producing wrapper leaf tobacco than any other soil in the area, though falling considerably short of an ideal soil for that purpose.

The Hanover sand, owing to its shallowness and frequently unfavorable location on steep slopes, is not as desirable for any agricultural purpose as the foregoing soils. Under favorable conditions of abundant rainfall fair crops of corn, rye, and tobacco may be produced. The soil is adversely affected by drought to a greater extent than any other in the area.

The Mackinaw gravel, where occurring in areas of more than 1 or 2 acres in extent, is not suited to farming operations. This is so generally recognized that the greater proportion of it is included within pasture lands. It is quite often forested.

The Miami black clay loam exists in only a few small scattered areas. It is a preeminently fertile corn soil and if more largely developed would be one of the most important types of the region.

The undrained meadows and marshes should be reclaimed to form highly productive fields, especially adapted in the case of the Muck to the growing of celery, cabbages, and cucumbers.

The agriculture of this area is thus capable of much greater specialization than it has yet attained, though the prosperous condition of the farmers at the present time is apt to delay rather than accelerate this phase of development. Fully 85 per cent of the area already consists of well-improved farms, and the future growth of agriculture in the region thus depends more upon specialization in cropping than on extension of the area farmed.

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LEGEND

